Late Pridolian Graptolites from the Elmside Formation near Yass, New South Wales

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A graptolite fauna from the lower Elmside Formation is described. It is the youngest known from the Siluro-Devonian sequence of the Yass syncline and allows greater precision in the recognition of the Silurian-Devonian boundary in this classic sequence. The assemblage includes *Monograptus* cf. *angustidens* Přibyl, *M. transgrediens* Perner, *M. transgrediens* cf. *praecipuus* Přibyl, *M.* cf. *formosus* Bouček and *Linograptus posthumus* Richter and is dated as Late Pridolian in age.

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INTRODUCTION

New graptolite horizons have been discovered at levels higher than any previously reported from the Siluro-Devonian sequence of the Yass syncline in southeastern N.S.W. They occur in the lower half of the Elmside Formation of Link (1970) and are close to the internationally agreed boundary between the Silurian and Devonian systems.

STRATIGRAPHIC SETTING

Several formations in the succession below the Elmside Formation have yielded graptolites and Jaeger (1967) has dated them as Late Ludlovian (e.g. Black Bog Shale Formation) to Pridolian (Cowridge Siltstone Formation). The Elmside Formation itself has been dated by Link and Druce (1972) using conodonts from the upper levels. The faunas were Lochkovian in age (Early Devonian) and these authors presumed that the base of the Devonian coincided with the base of the formation. However, Philip (1971, p. 14) regarded only the upper parts of the formation as Devonian, citing as evidence reports of *Encrinurus* in the 'Upper Trilobite Bed' in the Elmside Formation at Bowning. Although his view is supported by the graptolites described in this paper, Strusz (1980, p. 28) has shown that the outcrops in question represent the Black Bog Shale Formation (Ludlovian) — not the Elmside Formation.

The graptolite assemblage occurs in the lowest 20 m of the Elmside Formation, in the lower sandstone division of the formation (Fig. 1). They were collected from a road cutting on the southwestern side of the Black Range Road, 300m north-northwest of 'Spring Mount', 5.5 km northwest of Yass (1:100,000 Sheet grid reference 696446; see Fig. 2). The base of the formation is clearly exposed in the cutting. It is marked as the first appearance of sandstones interbedded with shales. The limestone lenses which yielded conodonts of the Lochkovian *Icriodus woschmidti* Zone (Link and Druce, 1972, p. 8) occur several hundreds of metres away to the west of the cutting, and in the upper half of the formation.

The graptolite horizons occur amongst olive and tan coloured sandstones and siltstones. The sandstones are quartzitic, of medium grainsize and reach 0.4 m in thickness. Sedimentation appears to have been by a combination of turbidity and traction current processes. Graded bedding, flute-marks, convoluted bedding, and rippled- and cross-bedding are present.

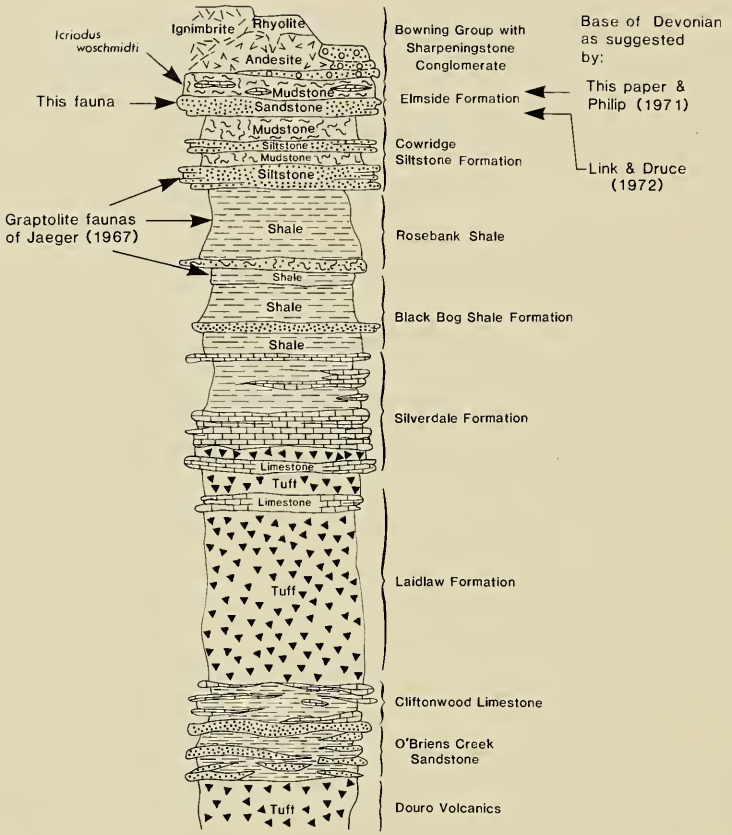


Fig. 1. Stratigraphic position of fauna, in relation to other graptolites and conodonts. Column modified after Link and Druce (1972).

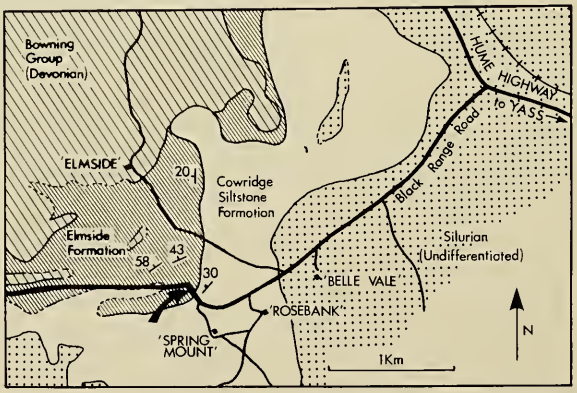


Fig. 2. Location of fauna. Map modified from Link and Druce (1972).

For the greater part, the section is structurally uncomplicated and dips on the bedding are at 35° towards 130°. Only at the northern end do small faults and gentle folds appear.

The preservation of the graptolites is good. They are flattened but not tectonically deformed, and the carbonized periderm is usually still present. A few sparsely-distributed trilobites, brachiopods, conularids and scolecodonts are associated with the graptolites. Some beds contain abundant broken plant material.

The Graptolites

Linograptus posthumus Richter 1875.

This form is exceedingly abundant in all collections through about 20 m stratigraphic thickness. Several specimens with sicular cladia have been recovered (Figs 3A,B). As in typical forms of this species in other regions the thecal spacings are about 9-10 th/cm. The stipes widen imperceptibly from 0.3-0.4 mm at th 1 to 0.7-0.8 mm distally. Minimum widths between the distal thecal apertures are 0.3 mm. Broken, separated sections representing just the metasiculae are 1-1.2 mm long and rather tubular in shape (0.2 mm wide). Distal thecal apertures occasionally show evidence of cortical thickening and low, rounded lateral lappets (Fig. 3D). The longest observed stipe portion is 3 cm (not including the long extended virgula). *L. posthumus* is a long-ranging species from the Ludlovian into the Lochkovian (Devonian) and is of little use for dating the fauna precisely.

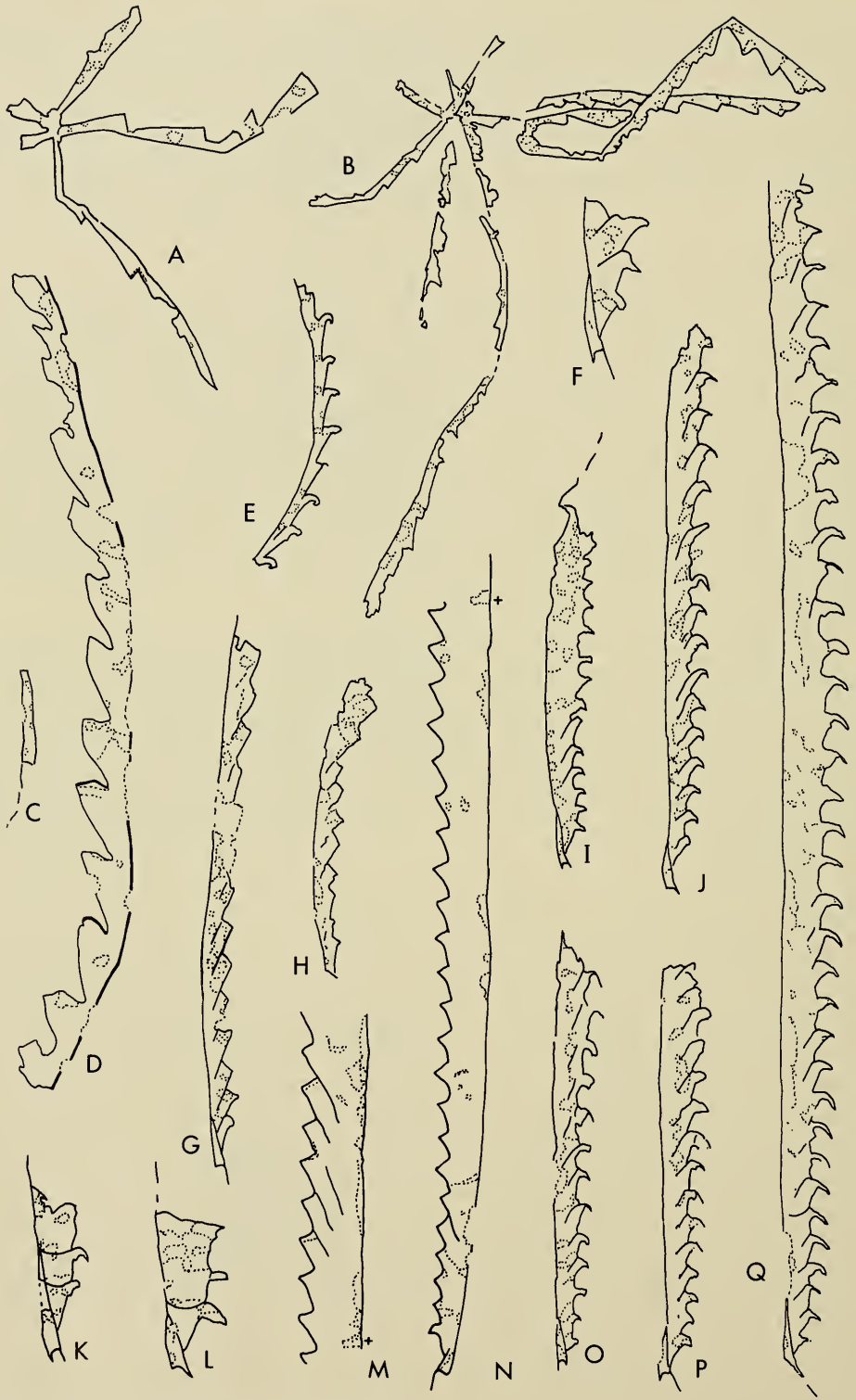
Monograptus cf. *angustidens* Přibyl 1940.

The graptolites represented in Figs 3 **F, I-L, O-Q** appear to constitute a single, morphologically variable species. This is indicated by the slight continuous variation that affects virtually all dimensions. In each case the variation coefficients are about 15%. The variation is also seen in their general appearances. Thus, while some specimens are like *Monograptus bouceki* Přibyl in having a straight dorsal margin to the thecal series at the proximal end, others have a tapered stipe proximally, which is more like *M. angustidens*. The collections are thus apparently intermediate between these two species.

Jaeger (1967) has already described *M. bouceki* from the stratigraphically lower Cowridge Siltstone of the Yass syncline. These older specimens, however, show no tendency to adopt the characteristics of *M. angustidens*.

The following dimensions are representative of the collections. The rhabdosomes may reach 40 mm in length, but are usually less than 20 mm. The siculae average 1.2 mm in length (range: 0.9-1.8 mm) and their apices reach to levels between the th 1 aperture and just above the th 2 aperture. In specimens with a straight dorsal margin to the thecae, the 0.25 mm wide sicula produces a strong dorsal deflection of the rhabdosome. In others that are related more closely to *M. angustidens* this deflection only corrects for the strong curvature between th 1 and th 10. A virgellar spine usually projects down and ventrally at 20-35° from the axis of the rhabdosome. The thecae are strongly hooked, though in a few individuals this form may weaken very slightly for the thecae beyond th 10. Stipe widths are 0.6-0.9 mm at th 1, 1.0-1.3 mm at th 5, 1.25-1.5 mm at th 10 increasing steadily to (at most) 1.7 mm distally. Stipe widths between the thecal apertures grow from 0.4 mm just above th 1, to 0.9 mm distally. Thecal spacings are 13-14/cm proximally and 10-11/cm beyond th 10. The distal interthecal septa measure about 0.8 mm in length and are inclined at about 20° to the dorsal margin.

Some of the dimensions differ consistently from the values found in overseas specimens of *M. angustidens* and *M. bouceki*, perhaps reflecting geographic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subspeciation. The siculae are generally shorter and do not extend up as far as th 3. The thecae are less closely spaced proximally and the stipes are wider at full development.

Monograptus cf. *formosus* Bouček 1931.

A single incomplete specimen (Fig. 3E) represents a 9 mm long portion of strongly dorsally curved stipe that is only 0.25 mm wide between the thecae and 0.7-0.8 mm wide at the hooked, partly-isolated thecae. The interthecal septa are about 0.5 mm long. The fragment appears to represent a middle portion of the graptolite, where the thecae are spaced at 10/cm. These dimensions compare well with those of the *M. formosus* from the Rosebank Shale in the Yass syncline, (Jaeger, 1967, pl, 14, figs. b, c) and from overseas successions. The form is not *Monograptus paraformosus* Jackson and Lenz (1969) as the thecae are only moderately isolated.

Monograptus transgrediens Perner 1899.

This graptolite is present, but never common in the beds. It attains 30 mm in length and 1.8 mm in width. Except for th 1 which appears to be slightly hooked or to have lappets, all thecae are simple. Distal thecae are spaced at 9th/cm, proximal thecae at about 12th/cm. The sicula is about 1 mm long and has a ventral virgella. The rhabdosome is strongly tapered at the proximal end, causing a pronounced ventral curvature of the dorsal margin.

Monograptus transgrediens cf. *praecipuus* Přibyl 1940.

Only two specimens are available (Figs 3 G-H). They possess the distinctive ventral curvature of the proximal parts in the stipes, the rather narrow stripe width (1.2-1.7 mm) in fully-developed overseas examples), and the mainly pristiograptid thecae, except for th 1 and 2 which Lenz and Jackson (1971) describe as having a 'beak-like profile'. This may be due to the presence of substantial lappets at the apertures. The Yass specimens reach up to 23 mm in length and have stipe widths of 0.5-0.7 mm at th 1, 0.7-0.8 mm at th 5, and 0.8-1.0 mm at th 10. One possible distal fragment (not figured) has a width of 1.8 mm. One sicula is 1.3 mm long, with its apex lying level with the aperture of th 1. The primary difference between this and overseas representatives is the lesser stipe width at th 10.

Faunal Relationships

Late Silurian and Early Devonian graptoloid faunas show no detectable geographic provincialism and can be used for very accurate worldwide biostratigraphic correlation (Jaeger, 1978).

The fauna in the lower Elmside Formation is clearly late Pridolian in age. It is a natural continuation of the graptolite faunas occurring lower in the Yass sequence and it contains several species in common with the older faunas.

M. angustidens (as *M. uniformis angustidens*) is reported as a short-ranged species characteristic of the very base of the Lochkovian (Jaeger, 1977). However, it is also recorded from the very uppermost Pridolian, apparently below the first appearance of *Monograptus uniformis uniformis* Přibyl — as for instance in Canada,

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Fig. 3. Graptolites from the Elmside Formation, near Yass, NSW. **A-D.** *Linograptus posthumus* (Richter). **A**, 35971. **B**, 35907. **C**, 35965. **D**, 35967. **E**, *Monograptus formosus* Bouček, 35910. **F**, **I-L**, **O-Q**. *Monograptus* cf. *angustidens* Přibyl. **F**, 35920. **I**, 35920. **J**, 35895. **K**, **L**, 35964. **O**, 35896. **P**, 35899. **Q**, 35908. **G-H**. *Monograptus transgrediens* cf. *praecipuus* Přibyl. **G**, 35911 & 35916. **H**, 35915. **M-N**, 35925. All specimens held in Australian National University Palaeontology Collection. All magnifications are × 5.0 except **C**, **D**, **F**, **K** and **L** which are × 10.

Poland and probably Czechoslovakia (Lenz and Jackson, 1971; Tomczyk *et al.*, 1977; Teller, 1964; Jaeger, 1967). Representatives in the lower Elmside Formation, appear to represent an early intermediate of this form with the older species *M. bouceki*, which is usually regarded as typical of graptolite horizons from lower to middle Pridolian. *M. uniformis* — the primary species which indicates the base of the Devonian — has not appeared in any of the graptolite collections. A further indication that the faunas are not Devonian is the presence of *M. transgrediens* (Jaeger, 1977).

The Elmside Formation graptolite assemblages reinforce the conodont-based biostratigraphy of Link and Druce (1972) which dated limestones bearing *Icriodus woschmidti* in the upper Elmside Formation as basal Lochkovian. However, they have made it possible to locate the boundary of the Devonian more accurately in the succession, and show that it lies in the middle part of the Elmside Formation.

Acknowledgements

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